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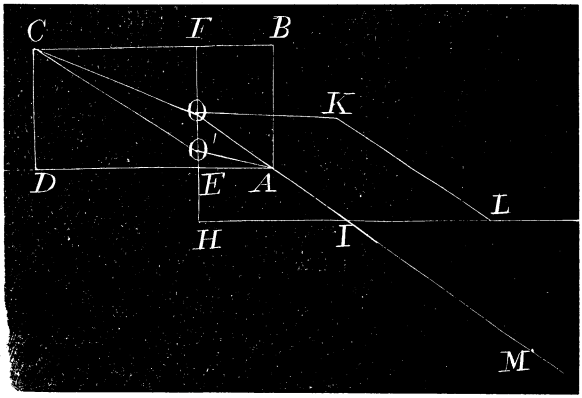
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Take any point O in EF. Draw $OI = OC$, and through I draw HL perp. to OE produced.

Take $IM = OC$ and draw OK and KL each equal to OC. The rate of travel may be regarded as 2 and 1.



The time in KOC at rate 1 $= OC$ at rate 1+ MO at rate 2, and time from K to C at rate 1 will be least when KOC is a straight line, and when it is least its half will be least likewise. The time from L to O at rate 2 will be least when LKO is a straight line, and at rate 2 it is equal half the time in KOC at rate 1. KO is common to KOC and LKO, $\therefore$ $LKOC$ must be a straight line; $\therefore$ because LO = 2OC, HO = 2OF.

In the triangles OIH and OAE we have OI : OH :: OA : OE. Substituting CO for OI and 2OF for OH and multiplying extremes and means,

$$CO \times OE = 2OF \times OA. \qquad (1)$$

Putting AE $= a$, CF $= b$, EF $= c$, EO $= x$ and FO $= c - x$, we get

$$x\sqrt{[b^2+(c-x)^2]} = 2(c-x)\sqrt{[x^2+a^2]}.$$

QUERY. "Which of the two following statemens is correct?

'The point $x'y'z'$ is a multiple point of the order k, if all the differential coefficients of the order $k-1$ vanish for that point." (Salmon, *Higher Plane Curves*, Art. 73.)

'Il s'ensuit que, pour un point multiple de l'ordre n, il est *ne'cessaire, mais non suffisant*, que les de'rive'es partielles de la fonction f des ordres infe'rieurs a' n s'annulent tontes pour les co-ordonne'es du point m.' (Serret, *Calcul. Diffe'rential*, Art. 16.)"

[Chas. H. Kummell writes, "Mr. Serret evidently means *real* multiple points, viz., the case where the equation of the nth degree for $\frac{dy}{dx}$ has more than one real root, in which case we have a *visible* multiple point."

A. S. Hathaway writes, "Salmon and Serret differ as to what is the order of a multiple point whose coordinates x_0, y_0 make the partial derivatives of f, below the nth order vanish.

Serret reckons by the number of *real* branches at the point. * * *

Salmon means by a multiple point of order n, a point, every line through which meets the curve there in n coincident points." * * *